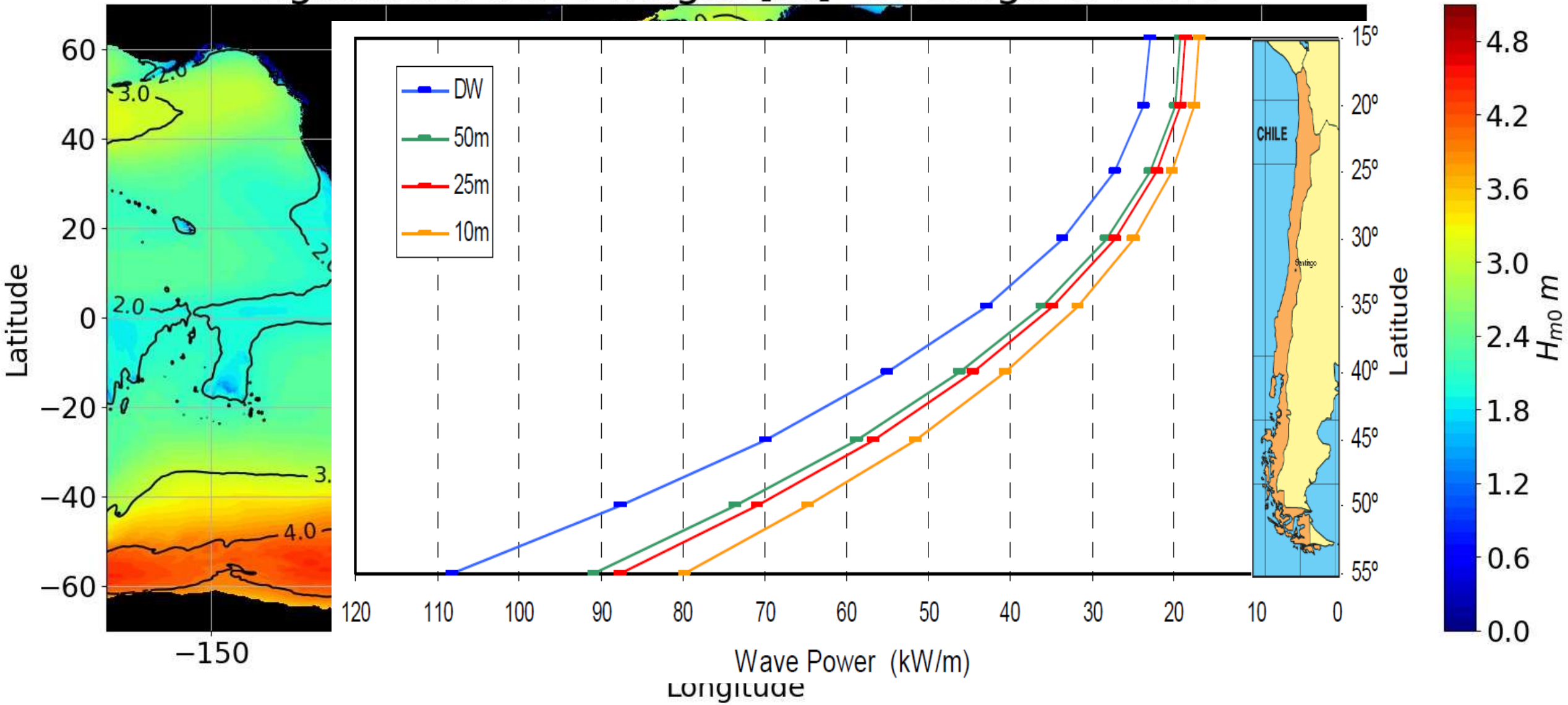
Experimental assessment of the effect of water depth on mooring line tensions for two different WEC mooring configurations under solitary waves

Álvaro Gallardo Rivera

Gonzalo Tampier, Patricio Winckle, José Ahumada

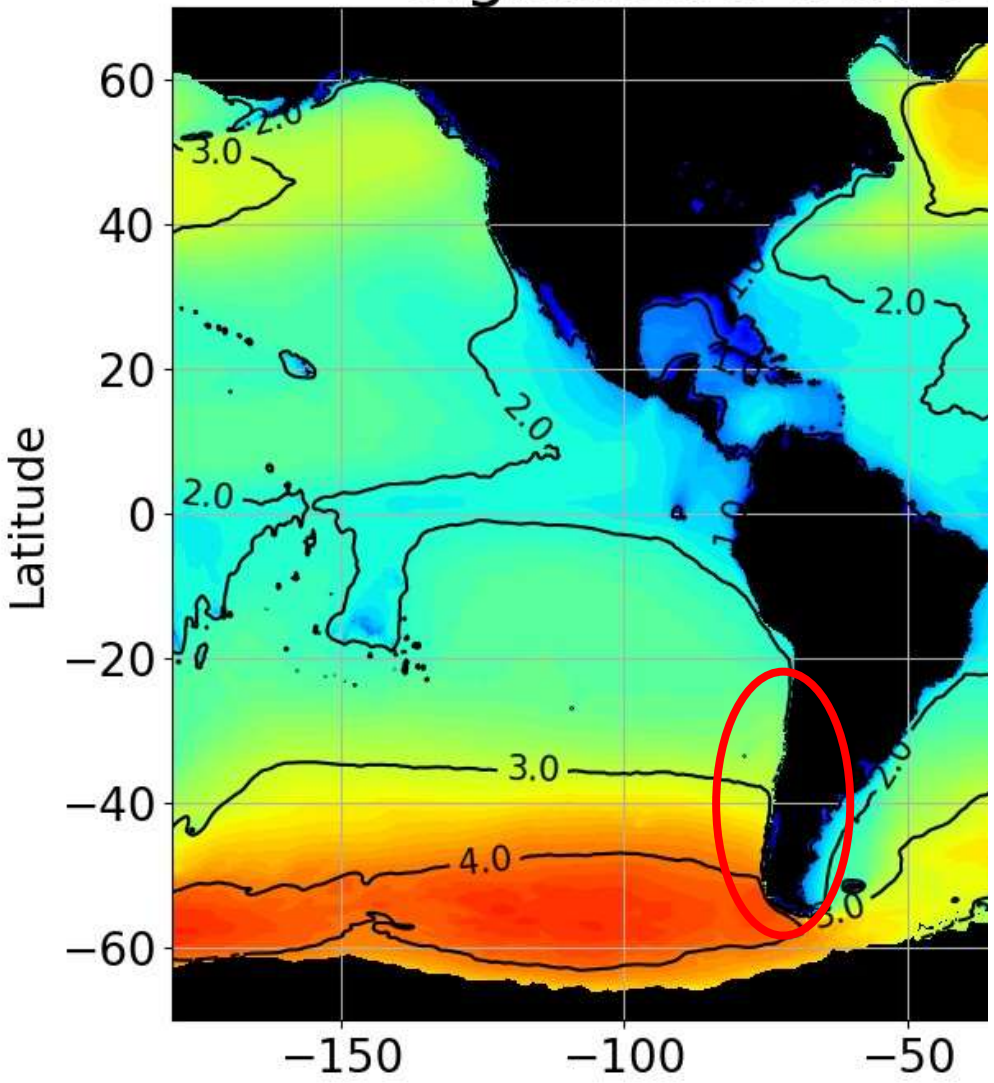
Barranquilla
22 of January 2024

Resource



Source: Monardez et. al, 2008

Resource



Wave resource is abundant and has a low variability*

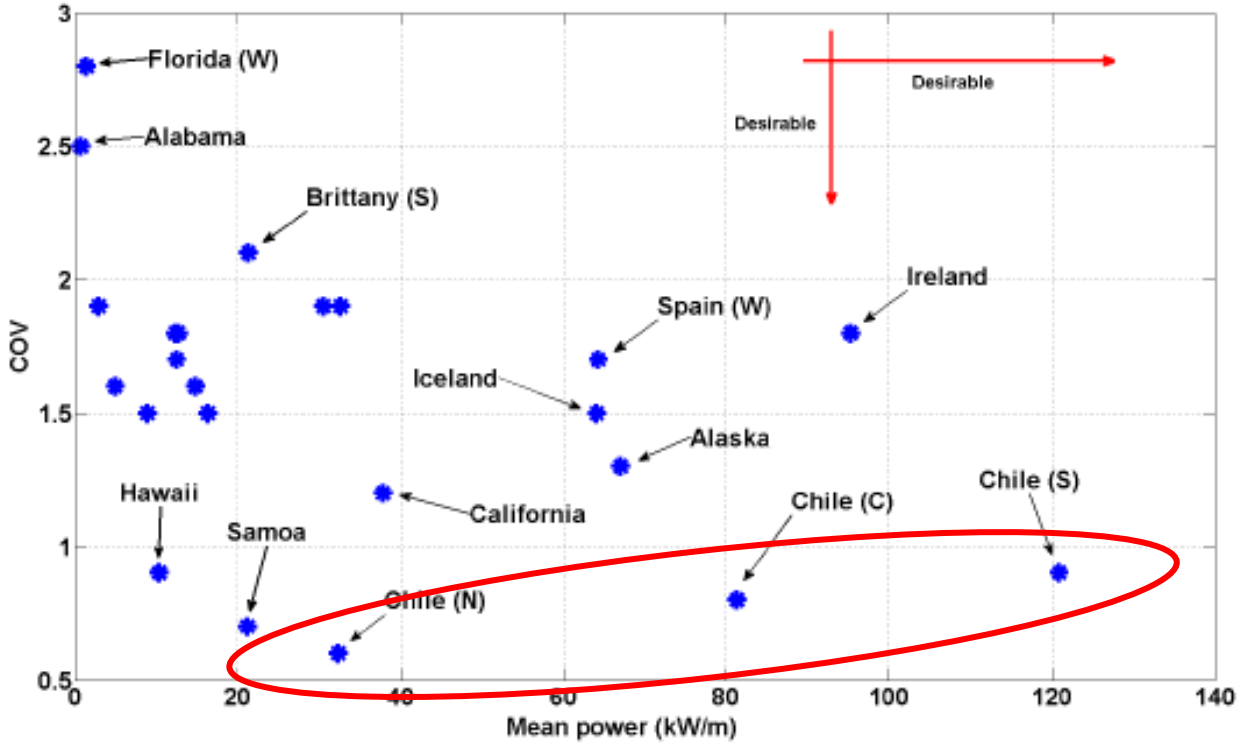
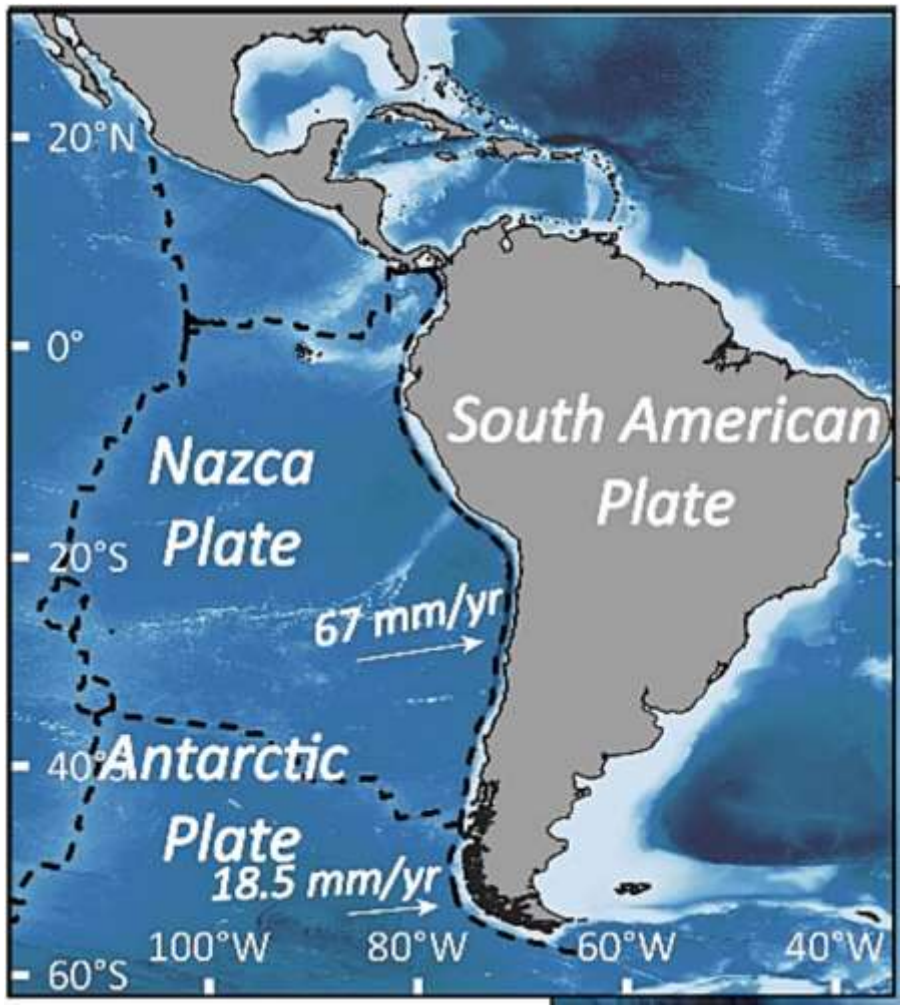


Fig. 5. Mean power and COV for various sites ordered by mean power

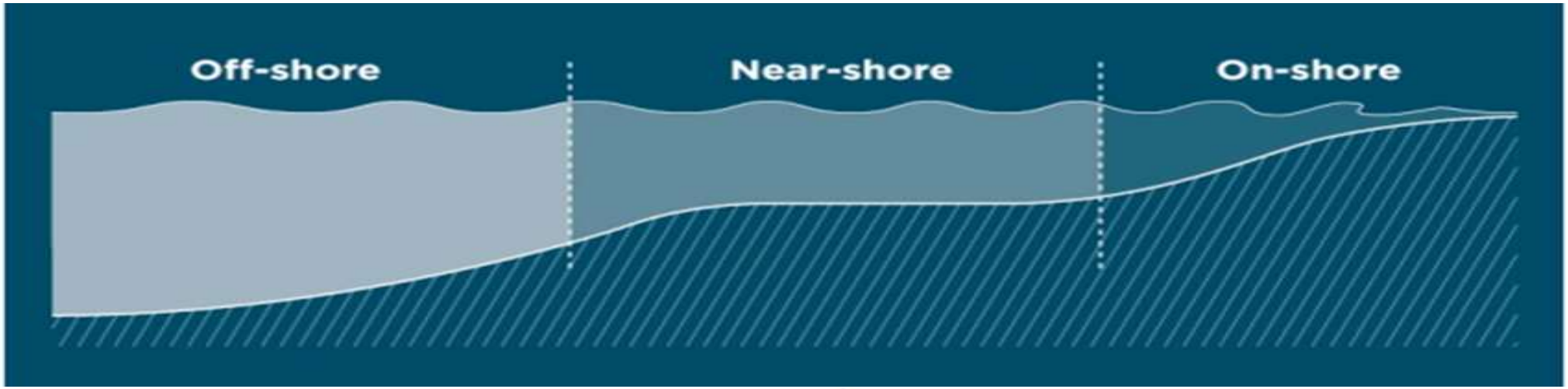
Source: Ringwood, John and Brandle, Gabriel (2015) A new world map for wave power with a focus on variability. Proceedings of the 11th European Wave and Tidal Energy Conference. ISSN 2309-1983

Tsunamis in Chile



- On average, one tsunami every 14 years
- WEC expected service life: 20 years

Local Conditions in Chile

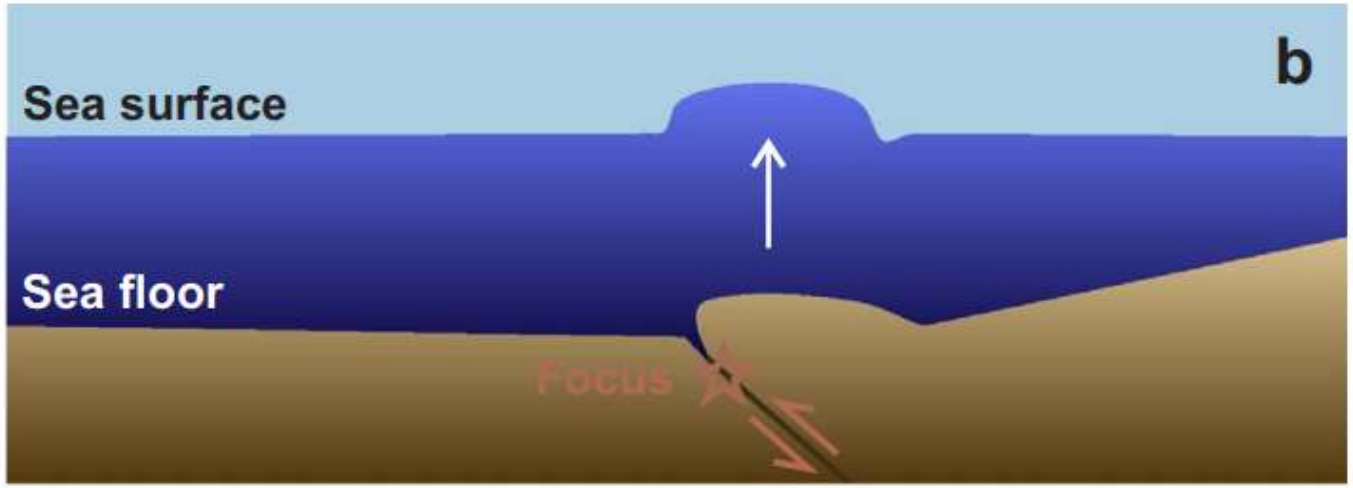


RESOURCE / COSTS

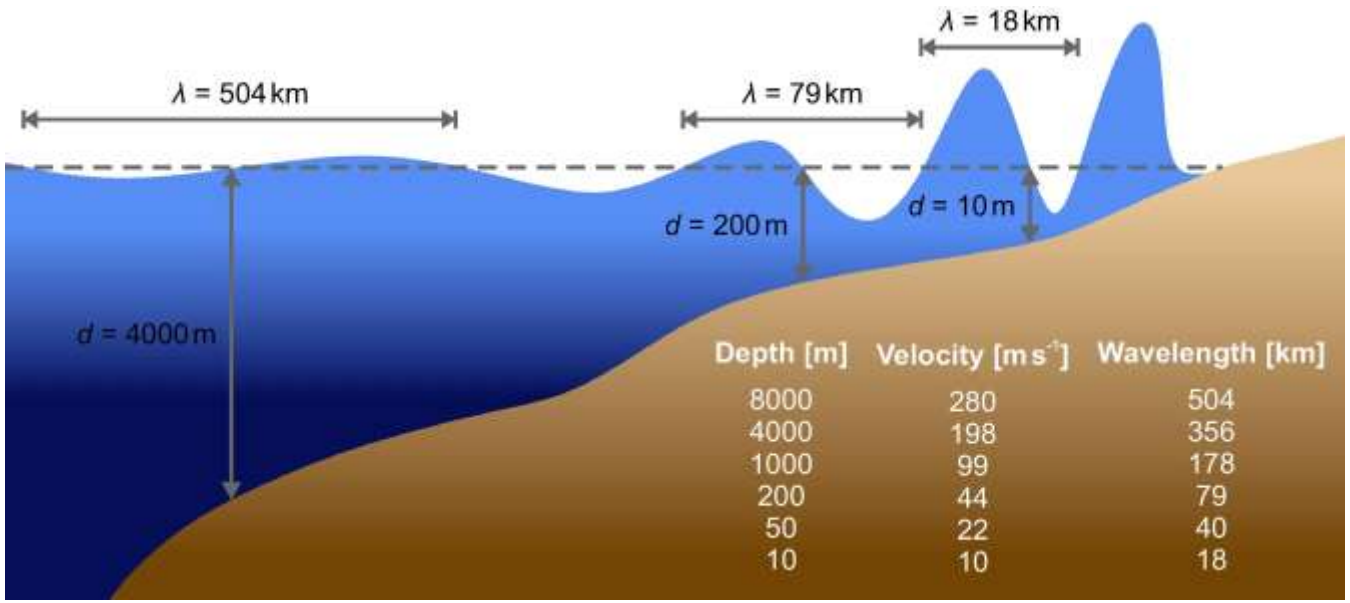
Local Conditions in Chile

TSUNAMI RISK

The tsunami phenomenon



- L >> H
- Linear behavior

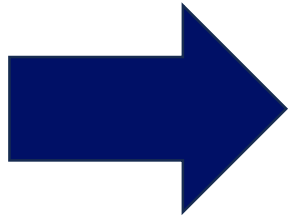


- Wave transformation
- Non-linear behavior

Tsunami modelling

Initial wave profile

Bathymetry



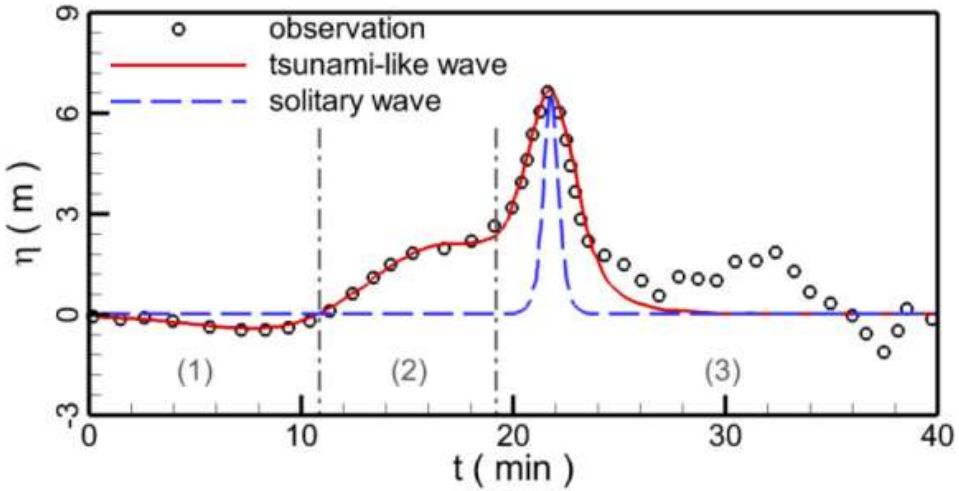
Wave transformation

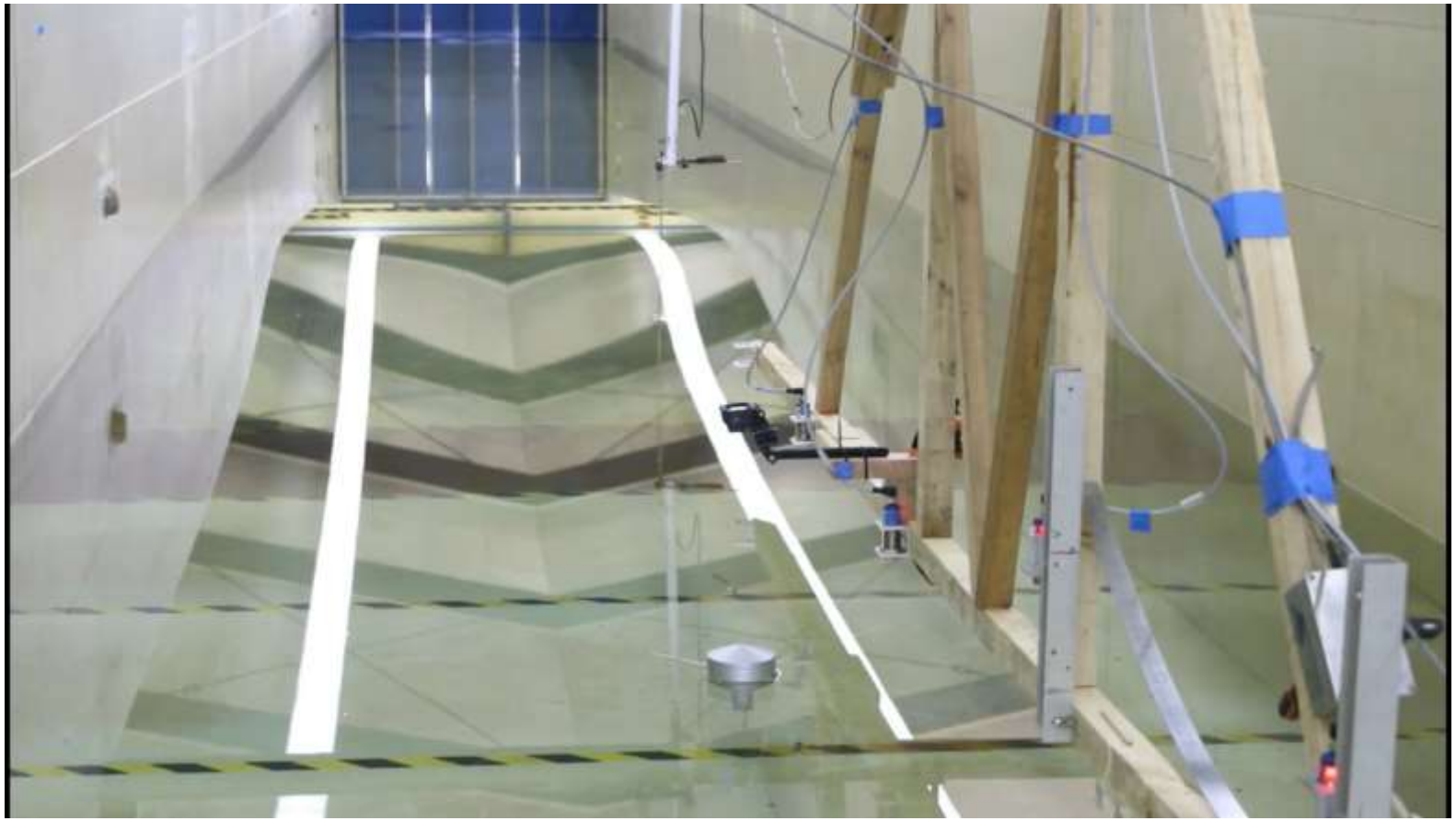
Wave-structure interaction

Run-up, inundation

Methodology

- Physical model
- 1:75 scale
- Solitary waves
- Generic models
- Simple bathymetry

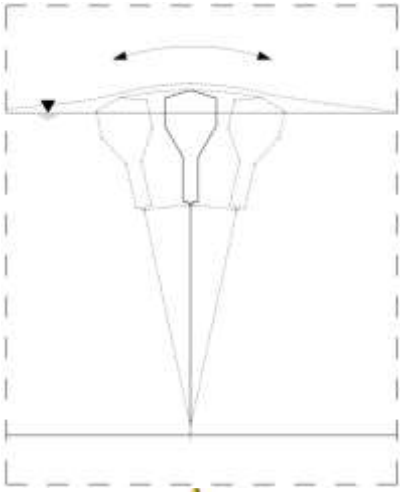


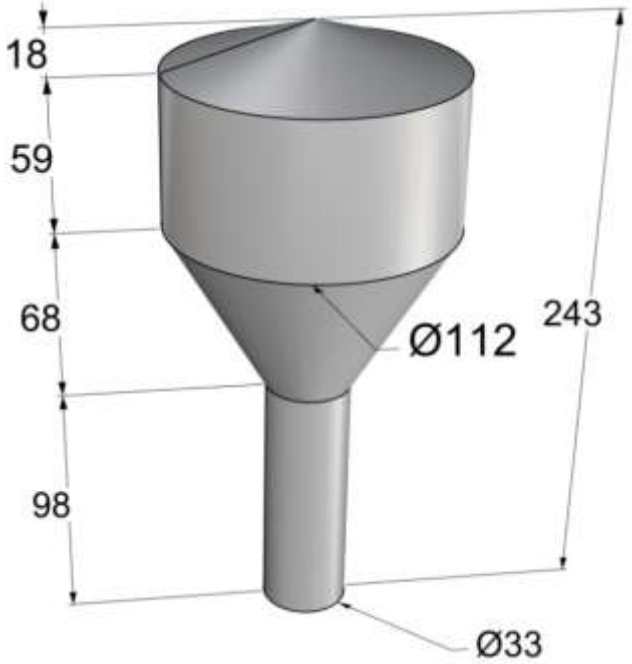


Generic WEC models

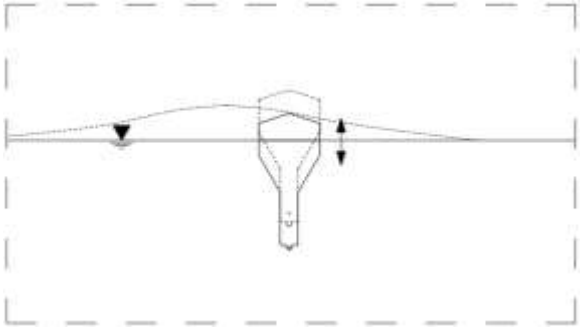
Point absorber

Vertical mooring

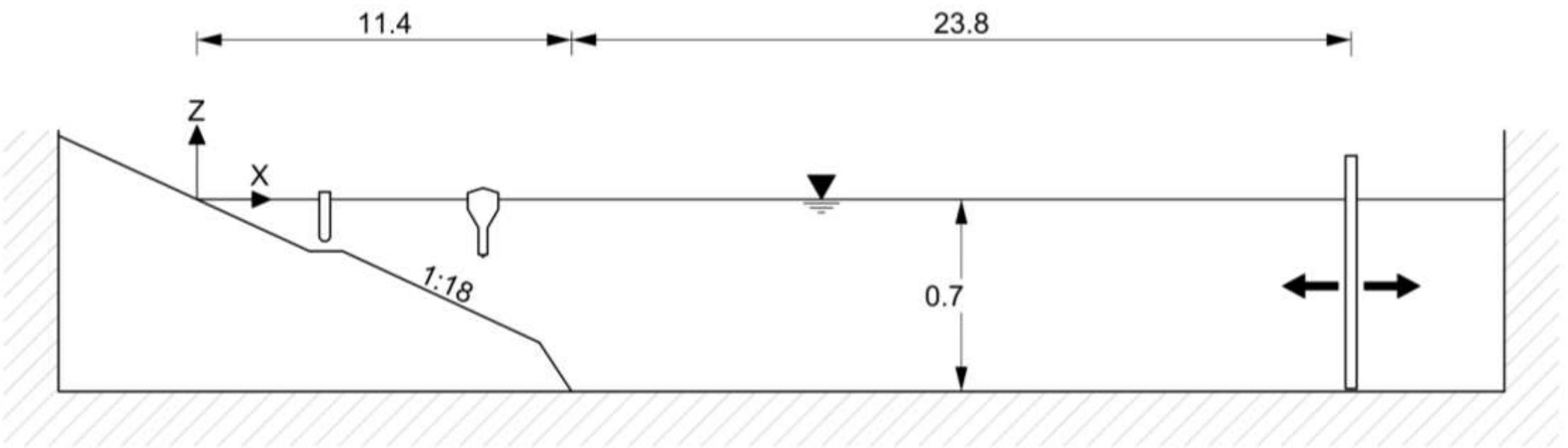




Horizontal mooring

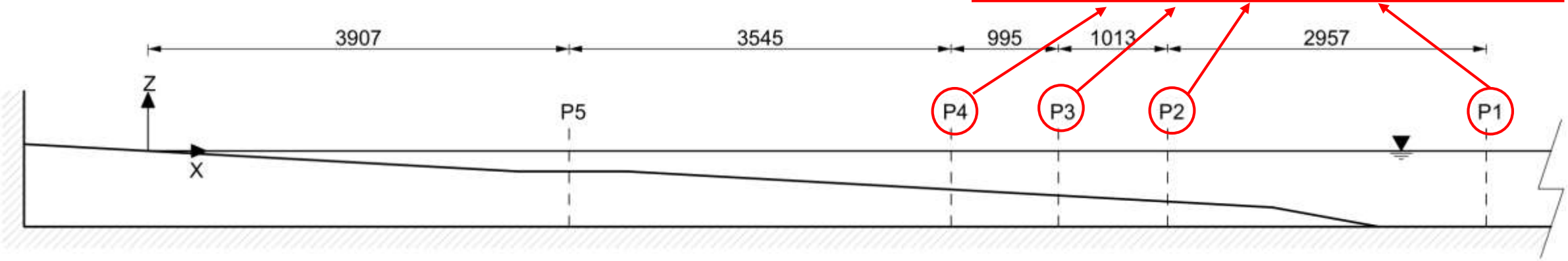


Experimental setup

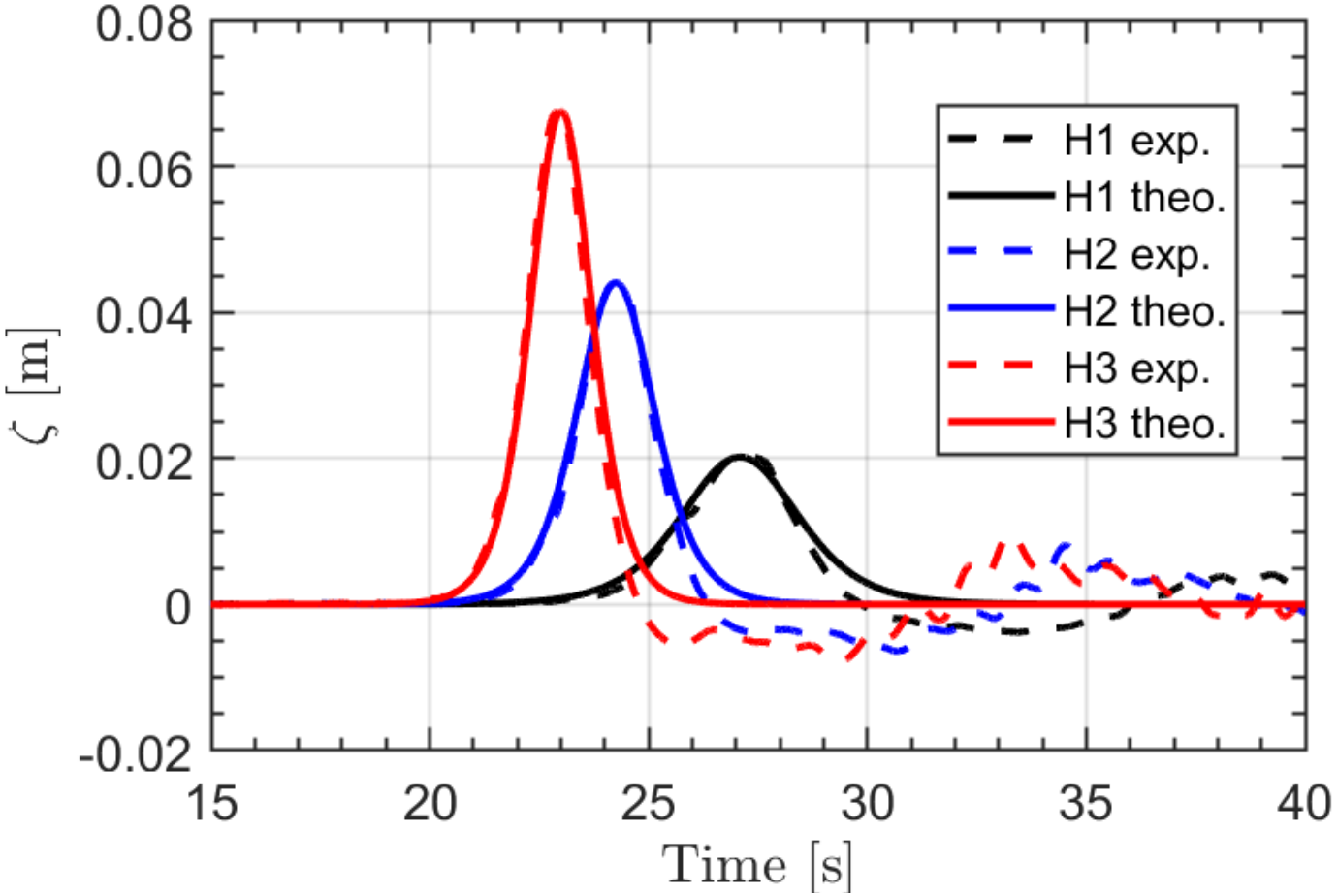


Installation positions

Posición WECs	$h\,[m]$	$h_{FS}\,[m]$	h/h_{max}
P1	0.700	52.50	1
P2	0.467	34.88	0.66
P3	0.413	30.53	0.58
P4	0.359	26.25	0.50
P5	0.189	13.43	0.26

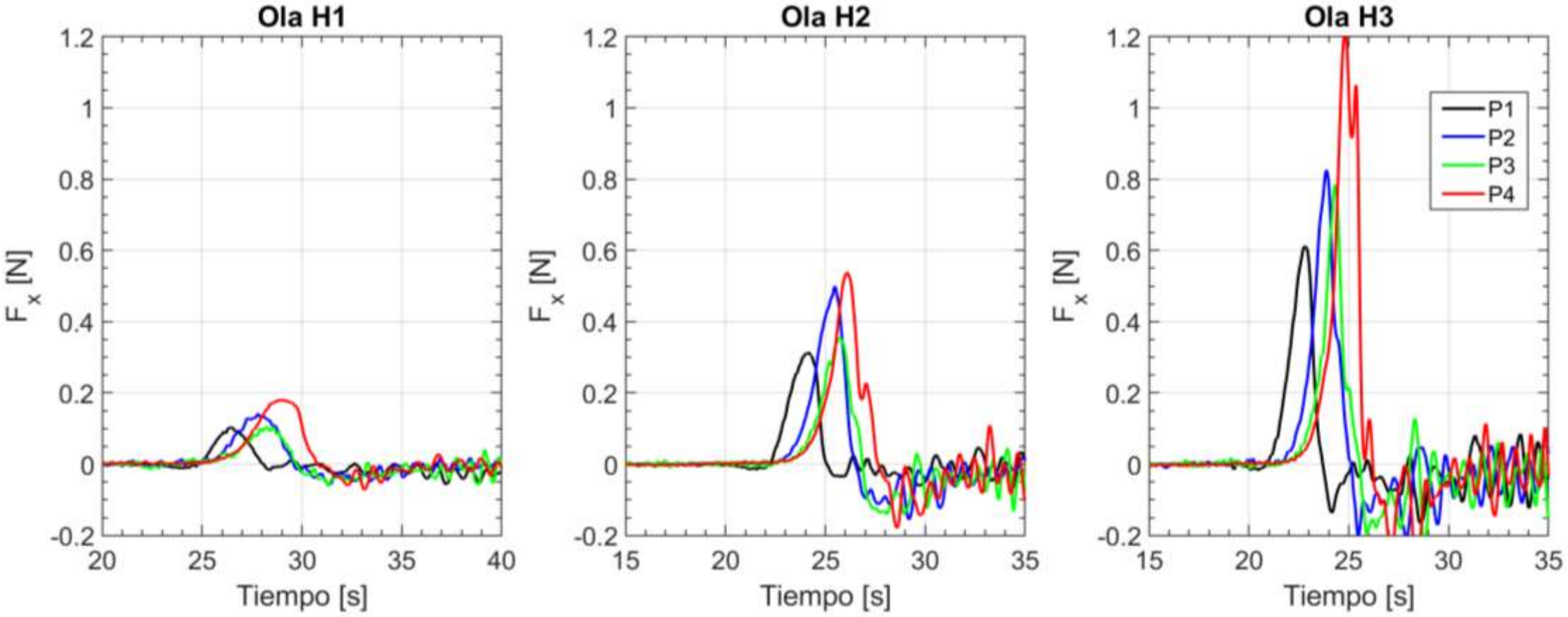


Waves

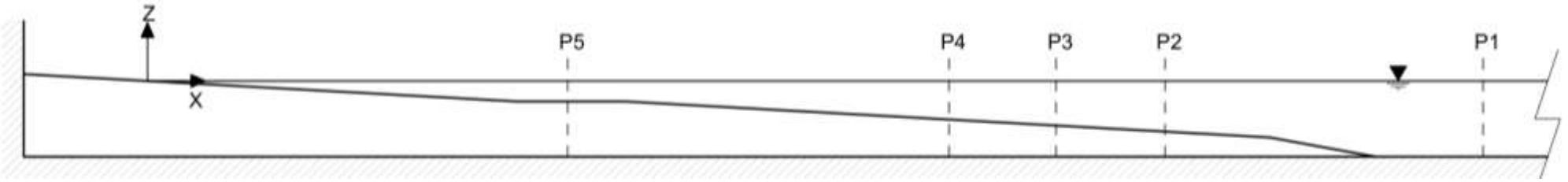


Ola solitaria	H_{gen} [m]	H [m]	H_{FS} [m]	c [m/s]	k [1/m]	L [m]	H/h	h/L
H1	0.026	0.020	1.5	2.658	0.210	29.897	0.029	0.023
H2	0.053	0.044	3.3	2.701	0.310	20.257	0.063	0.035
H3	0.080	0.068	5.1	2.744	0.384	16.355	0.097	0.043

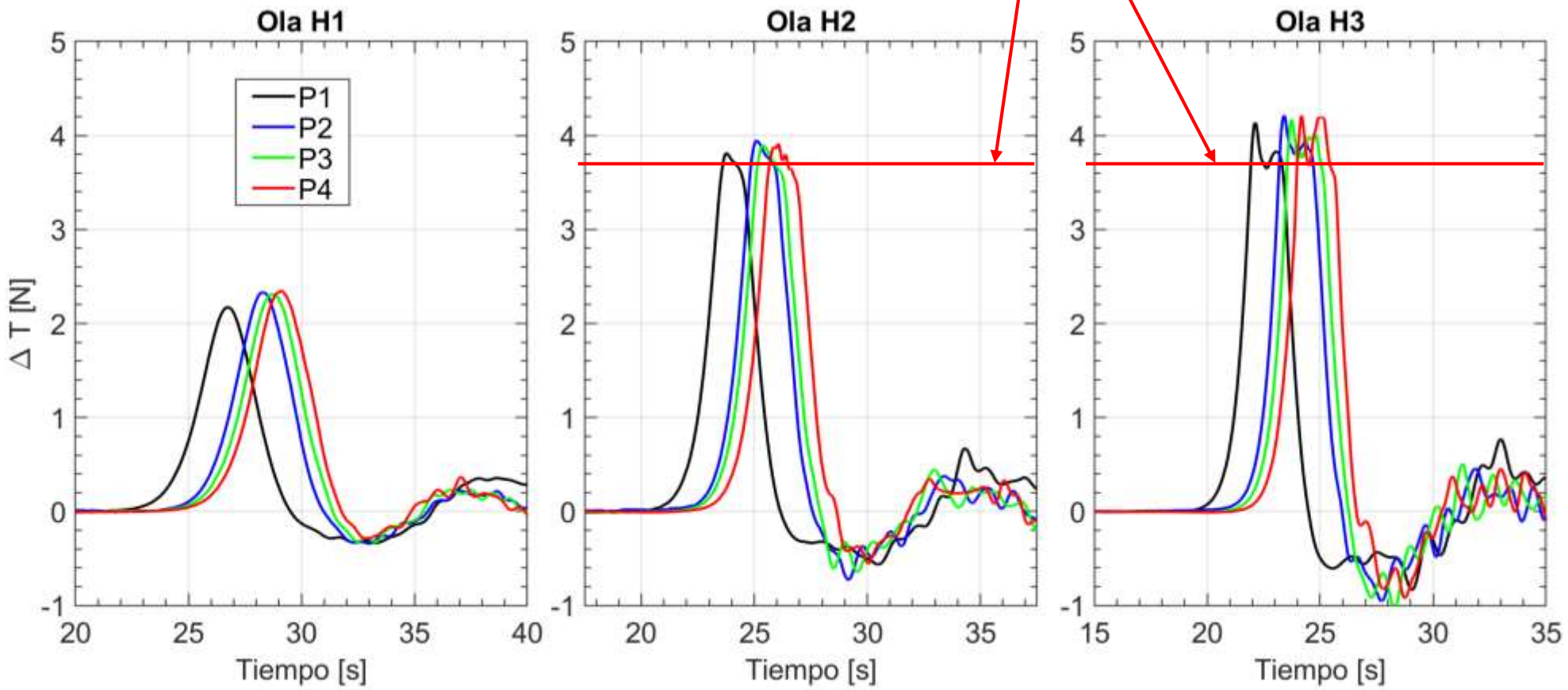
Results: horizontal mooring

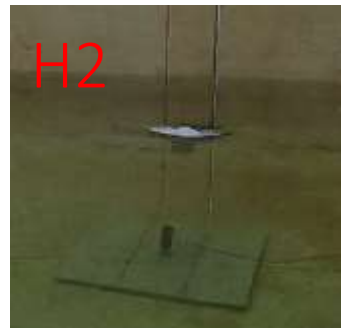


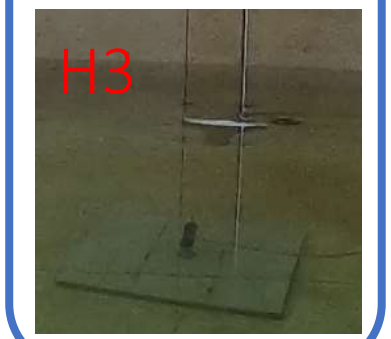
Results: vertical mooring



Bouyancy reserve= 3.68 [N]







Conclusions and future work

- Results can be considered for mooring, technology and site selection.
- Depth and mooring configuration are crucial for survaviability evaluation of WEC.
- Vertical mooring has minimum wave forces.
- Numerical model needed to study more realistic conditions
- Compare this forces with extreme sea states

Thank you!

alvaro.gallardo@uach.cl